CASE REPORT

Percutaneous angioplasty and stenting of subclavian arteries before surgical coronary revascularization in a patient with an aberrant right subclavian artery

Angioplastie et stent des artères sous-clavières avant revascularisation coronaire chirurgicale chez un patient présentant une artère sous-clavière droite aberrante

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Abstract An aberrant right subclavian artery occurs in less than 2% of the population. An associated stenosis of the subclavian artery carries a risk of subclavian-coronary steal in patients who undergo coronary revascularization. We report on the case of a 54-year-old man admitted to our hospital for a coronary artery bypass graft (CABG). Angiographic examination revealed bilateral subclavian-artery stenosis with an aberrant right subclavian artery, anomalous origin of the right vertebral artery from the right common carotid artery, and left vertebral-artery occlusion. The patient underwent successful bilateral subclavian angioplasty and stenting.

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Introduction

An aberrant right subclavian artery (ARSCA) is the most common congenital anomaly of the intrathoracic major arteries and occurs in approximately 0.4-2% of the population. This malformation results from an interruption between the right common carotid artery and the ARSCA in the developing aortic arch [9]. In this anomaly, the right common carotid artery is the first branch to arise from the arch, followed by the left common carotid artery and the left subclavian artery, with the ARSCA being the last branch, crossing the mediastinum behind the esophagus from left to right [6,16]. Although most patients with ARSCA are asymptomatic, on occasions, this anomaly may present with dysphagia, superior mediastinal mass, chronic cough or respiratory compromise in children [5,14,22]. Screening for subclavian-artery stenosis in patients who are candidates for internal mammary–coronary bypass grafting and further management by conventional surgical transposition or endoluminal repair has been evaluated in a number of studies [1,3,17,18,21]. We report a case of bilateral subclavian-artery stenosis in a patient with ARSCA, abnormal origin of the right vertebral artery from the right common carotid artery, and left vertebral-artery occlusion treated at our hospital with bilateral subclavian stenting before cardiac revascularization.

Case presentation

Our 54-year-old male patient experienced left chest pain while driving his car. He was admitted to the emergency unit of another hospital where initial resuscitation and percutaneous coronary intervention were performed. The patient was then transferred to our hospital for a further coronary artery bypass graft (CABG) to correct residual stenosis after percutaneous cardiac intervention. The cardiac surgeon called for a clinical evaluation to be done before the planned internal mammary-CABG.

Upon examination, the patient had sensory aphasia due to cerebral ischemia at the time of cardiac compromise, but no symptoms of cranial nerve palsy, weakness or seizures and no blood pressure discrepancy between both arms. A brain MRI revealed left temporoparietal cortical infarction. Angiographic examination with three-dimensional CT angiography (Figs. 1 and 2A) revealed bilateral subclavian-artery stenosis and left vertebral-artery occlusion with the following associated anomalies: ARSCA; anomalous origin of the right vertebral artery from the right common carotid artery, and the left subclavian artery arising at the junction between the aortic arch and descending aorta. The length of the stenotic segment was 22 mm in the RSCA, and the diameter of maximum stenosis was 4 mm. The diameter of the ARSCA distal to the stenosis was 9.5 mm, while the diameter proximal to the stenosis was 6.1 mm. The left subclavian artery showed the following measurements: stenotic segment was 22.7 mm in length; 2.9 mm was the maximum stenotic diameter, the diameter distal to the stenosis was 5.9 mm and the diameter proximal to the stenosis was 6.3 mm.

Details of the procedure were explained to the patient who gave his informed consent. The procedure was performed under local anesthesia in our angiography room, which is equipped with a biplanar digital subtraction angiography (DSA) (Shimadzu Corporation, Japan). Anticoagulation was initiated with 4000 units of heparin to maintain an activated clotting time of 250 to 300 s.

A 9-French (F) long sheath was introduced into the right femoral artery, and an additional 4-F regular sheath was introduced into the right brachial artery for stable navigation and deployment of the stent (Pull-Through Technique). A 9-F Britetip guiding catheter (Cordis Neurovascular, Miami Lakes, FL, USA) over a 6-F CX JB2 (Cathex, Kanagawa, Japan) and RF35 superflex coaxial system (Terumo, Tokyo, Japan) were also inserted (Fig. 2B). The optimal working angle was RAO30/Cranial 0. A Luminexx 1 0 × 20 mm stent (C.R. Bard, Inc) was deployed across the lesion. A satisfac-
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Corporated post-stent dilatation was achieved using a PowerFlex P3/9 × 20 mm catheter (Cordis Neurovascular, Miami Lakes, FL, USA). The supporting guidewire was navigated distally and crossed the lesion in the left subclavian artery down to the left brachial artery. A Palmaz stent 7 × 20 mm (Cordis Neurovascular, Miami Lakes, FL, USA) mounted over a PowerFlex P3/7 × 20 mm balloon catheter (10 atm/30 s) was deployed into the left subclavian artery (Fig. 2C).

Control angiography at the end of the procedure revealed satisfactory dilatation of both subclavian arteries (Fig. 2D). The procedure was technically successful and the patient followed a smooth postoperative course in the intensive care unit. The patient was maintained on the same preoperative antiplatelet medications – aspirin 100 mg per day and cilostazol 200 mg per day. The patient underwent cardiac revascularization 1 month later invol-

Figure 2. Aortic angiography performed at the beginning of the procedure confirms the diagnosis of CT angiography (a). Angiogram shows the guidewire crossing the stenosis of the aberrant right subclavian artery (b) and expandable balloon stent deployment in the left subclavian artery (c). Aortic angiography at the end of the procedure reveals the absence of residual stenosis of both subclavian arteries (d).

Figure 2. L’angiographie des troncs supra-aortiques réalisée en début de procédure confirme le diagnostic de l’angioscanner (a). L’angiogramme montre le guide franchissant la sténose de l’artère aberrante sous-clavière droite (b) et le déploiement du stent monté sur ballon dans l’artère sous-clavière gauche (c). L’angiographie en fin d’intervention montre l’absence de sténose résiduelle des artères sous-clavières (d).
ving both internal mammary arteries (IMA) and experienced an uneventful recovery.

Discussion

The ARSCA was first reported on autopsy by Hunauld in 1735, while the radiological finding of this anomaly was first described two centuries later by B.F. Kommerell, a German radiologist, in 1936 [8,12]. Normal development of the human aortic arch and great vessels includes the formation and regression of the paired vascular arches that connect the embryonic ventral aorta to the two dorsal aortas. The left fourth arch forms the aortic arch; the right fourth arch contributes to the formation of the right subclavian artery as well as the seventh intersegmental artery. In ARSCA, the right fourth arch and proximal right dorsal aorta involute, and the right seventh intersegmental artery develops from a persistent dorsal aorta [9,10,16].

The incidence of significant subclavian artery stenosis (50%) in patients undergoing coronary artery bypass graft (CABG) is 0.5–2.3% [7,15]. High-grade stenosis proximal to the origin of the IMA may lead to flow reversal in a patent left IMA graft, a phenomenon called subclavian-coronary steal syndrome characterized by impaired blood flow to the myocardium supplied by the graft. This highlights the importance of preoperative screening for subclavian stenosis [17,24].

In our patient, although the degree of stenosis in both subclavian arteries cannot be considered high-grade (57.8% on the right and 53.9% on the left), the plan after discussion with our cardiac surgeons was to perform bilateral subclavian stenting to protect the bypass graft from subclavian-coronary steal. The optimal diagnostic tool remains a matter of controversy, although routine conventional angiography has been recommended to identify the presence of stenosis [7]. Other studies restrict this invasive procedure to patients with upper-limb claudication, cerebrovascular ischemic symptoms, supraclavicular bruises, and a systolic blood pressure difference of 15 mmHg or more from one arm to the other [15,17,20].

Non-invasive imaging techniques are being used more frequently. Currently, we use three-dimensional CT angiography in our center for pretreatment imaging of aneurysmal subarachnoid hemorrhage, and for screening of subclavian artery stenosis, with high sensitivity and specificity. Carotid-subclavian artery bypass grafting was considered the procedure of choice for the treatment of associated subclavian stenosis and subclavian-coronary steal. Several studies have reported excellent patency rates with bypass grafts, good durability and minimal surgical complications [3,4,18].

Recently, the rapidly evolving technology of endovascular therapy has enabled us to treat various neurovascular pathologies using less invasive, relatively simple procedures. Percutaneous transluminal angioplasty with and without stents has emerged as an alternative to conventional repair in the management of subclavian atherosclerotic arterial stenosis, with variable results [1,2,5,13,19,23]. Azakie et al. [2] were the first to describe normalization of the blood-pressure discrepancy and improved neurological deficit after successful angioplasty and stenting of occlusive ARSCA. Basile et al. [5] reported successful endovascular treatment of a critical ostial stenosis in an ARSCA in a patient presenting with acute ischemia of the right forearm. In this case, the authors demonstrated that the treatment of an ostial stenosis is feasible using a transbrachial approach. Henry et al. [11], in their study of percutaneous transluminal angioplasty of subclavian occlusive lesions in 113 patients in a variety of indications (vertebrobasilar insufficiency, upper-limb ischemia, coronary steal syndrome or anticipated CABG), reported 2.6% procedural complications and 15.5% restenosis (primary and secondary patencies for all treated lesions at 8 years were 75 and 81%, respectively), while the primary and secondary patency rates for all 103 recanalized lesions were 83 and 90%, respectively. In another series of 69 consecutive patients with subclavian artery stenosis and occlusion [21], 76 stents were deployed with a procedure success rate of 96%, an overall primary patency rate of 73% and an overall secondary patency rate of 90%. Although the long-term patency noted with angioplasty may be slightly inferior to that with graft surgery [23,24], better results may yet be achieved with adequate follow-up programs enabling early detection and treatment of significant recurrent restenosis. High rates of surgery-related complications such as phrenic nerve palsy, Horner’s syndrome, lung atelectasis, graft thrombosis, pleural effusion, chylothorax and anesthetic complications have been reported [4,18]. The relative simplicity of angioplasty and stenting, the associated low rate of procedure-related complications and the advantage of requiring only local anesthesia in cardiac-compromised patients may favor its use over conventional surgical repair.

The present case demonstrates that an aberrant right subclavian artery stenosis can be treated safely with percutaneous stents, a relatively simple, minimally invasive technique with a low risk of procedure morbidity and requiring only local anesthesia in cardiac-compromised patients, before undergoing coronary bypass graft surgery.

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References


